METHOD AND DEVICE FOR ROTATING A FRICTIONAL SURFACE IN A FRICTION FEEDER

Field of the Invention

The invention disclosed herein relates generally to a feeder for feeding mail related items such as mail insert materials, envelopes or mailpieces and, more specifically, to a retarding element in a friction feeder for preventing multiple feeds.

Background of the Invention

Friction feeders are known in the art. As the name suggests, a friction feeder relies on the interaction of several components around the exit nip of the feeder that results in the singulation of paper documents in a paper stack. The common components in most friction feeders are the driving mechanism to drive a sheet of paper document out of the exit nip and the retarding element to retain all the other sheets in the stack so as to prevent multiple feeds. To provide the necessary friction for retaining the other sheets in the stack, the surface of the retarding element is usually made of an elastomeric material or a hard, rough coating. Ifkovits, Jr. et al. (U.S. Patent No. 5,294,102, hereafter referred to as Ifkovits) discloses a friction feeder wherein the surface of the retarding element is coated with tungsten carbide grit. Godlewski (U.S. Patent No. 4,666,140) discloses a friction feeder wherein the surface of the retarding element is made of an elastomeric-like material. Green (U.S. Patent No. 5,244, 198) discloses a friction feeder wherein the retarding element is a continuous belt made of an elastomeric material mounted on a pair of rollers. A friction feeder can be designed to operate as a top feeder or a bottom feeder. The above-mentioned friction feeders are bottom feeders, wherein the sheets in a generally vertical stack are moved out the stack, one at a time, by a driving mechanism below the stack. A typical friction feeder is shown in Figure 1. As shown, the feeder 1 uses a driving mechanism **30** to drive the bottom sheet **10** of a stack **20** out of the exit nip **64** and a retarding element **40** (a cylindrical member) to hold back the other bottom sheets. In general, the retarding element **40** has a relatively large diameter at the exit nip

so that a number of sheets at the bottom of the stack can fan out to follow the surface curvature of the retarding element, forming a singulated stack portion **24**. In the singulated portion, the sheets are slightly separated from each other in that the leading edge of one sheet is positioned slightly ahead of the sheets above. As shown in Figure 1, the driving mechanism **30** comprises a continuous belt **32** mounted on a pair of rollers **34**. However, the driving mechanism can simply be rollers with a resilient surface.

In order for the retarding element **40** to be effective in preventing other bottom sheets from being pulled out by the driving mechanism **30** along with the bottom sheet **10**, the retarding element **40** must have a high friction surface **50** which is fixedly mounted on a roller **42**. In operation, the high friction surface **50** is stationary relative to the moving sheet **10.** The friction between the bottom sheet **10** and the sheet 10' above is lower than the friction between the retarding surface **50** and a sheet **10'**. If the surface **50** of the retarding element **40** is coated with a layer of hard grit, as disclosed in Ifkovits, paper dust will accumulate at the surface section **52** at the feed zone **62** where the sheets in the singulated portion **24** are retained by the retarding element **40** when the bottom sheet **10** is driven out of the exit nip **64.** After extensive use, the surface roughness is reduced mainly because of the accumulated paper dust, thereby reducing the effectiveness of the retarding surface **50**. If the surface **50** of the retarding element **40** is made of an elastomeric material, as disclosed in Green and Godlewski, the contact between the sheets and the retarding surface **50** at the feed zone **62** will wear out the contact surface section **52**, changing the retard characteristics of the elastomeric surface.

In order to provide an unworn portion of the retarding surface to the exit nip, Green uses a locking mechanism to keep the retarding surface stationary in operation. When it is necessary to rotate the retarding surface to provide an unworn portion at the exit nip, the operator loosens the locking mechanism and manually repositions the retarding surface. This manual method of furnishing an unworn portion of the retarding surface is inconsistent and inconvenient.

Thus, it is advantageous and desirable to provide a method and device for rotating the retarding surface in a simple and consistent fashion.

Summary of the Invention

The present invention provides a method and device for facilitating the replacement of a worn out frictional surface by a fresh one in a friction feeder. This objective can be achieved by mounting a frictional surface on a roller, which is prevented from rotating about a shaft by a polygonal locking member. The locking member is slideably mounted on the same shaft. When the locking member is located at a locked position, it is prevented from being rotated by a blocking surface. But when the locking member is located at an unlocked position, it is allowed to rotate, causing the frictional surface to turn.

Thus, according to the first aspect of the present invention, there is provided a device for use in conjunction with a frictional mechanism in a feeder for releasing substantially flat items from a stack, wherein the feeder has a driving mechanism for driving the flat items at a lower section of the stack through a nip, and the frictional mechanism is disposed near the nip so as to allow one flat item to pass through the nip at a time, wherein the frictional mechanism comprises at least a roller having a frictional surface disposed on a circumference of the roller, and a circumferential section of the frictional surface is in contact with the flat items at the lower section of the stack, said device is used to facilitate replacement of said circumferential section of the frictional surface with another circumferential section of the frictional surface. The device comprises:

a locking member having a plurality of facets forming a polygonal outer circumference of the locking member, each facet coving an angular section;

a shaft, disposed in relation to the nip, for securely mounting the roller, the shaft having a longitudinal axis substantially parallel to the nip, wherein the shaft has a longitudinal section for slideably mounting the locking member, allowing the locking member to move from a first portion of the longitudinal section to a second portion of the longitudinal section when needed, while preventing the locking member from rotating relative to the shaft; and

a blocking mechanism, disposed relative to the first portion of the longitudinal section of the shaft, such that

when the locking member is positioned at the first portion of the longitudinal section of the shaft, one of the facets is at least partially in contact with the blocking mechanism, preventing the locking member from rotating about the longitudinal axis; and

when the locking member is positioned at the second portion of the longitudinal section of the shaft, the locking member is rotatable about the longitudinal axis, causing the shaft to turn, thereby achieving said replacement.

The locking member is rotated at least one angular section when the locking member is positioned at the second portion of the longitudinal section of the shaft, so that when the locking member is moved to the first portion of the longitudinal section of the shaft, a different one of the facets is substantially in contact with the blocking mechanism.

Preferably, the locking member has a non-circular cross section, and the longitudinal section of shaft has a substantially matching cross section for slideably mounting the locking member. Preferably, the non-circular cross section is polygonal in shape.

Preferably, the blocking mechanism comprises a surface which is in close proximity to said one of the facets when the locking member is positioned at the first portion of the longitudinal section of the shaft, and the surface is spaced from the locking member when the locking member when the locking member is positioned at the second portion of the longitudinal section of the shaft.

Advantageously, the feeder comprises a shaft mount for mounting the shaft for rotation about the longitudinal axis of the shaft, and wherein the blocking mechanism is fixedly mounted on the shaft mount.

Preferably, each of the flat items has two side edges substantially perpendicular to the nip, and said at least one roller comprises two rollers, each having a frictional surface disposed near a different one of the two side edges.

Preferably, the shaft has two ends for separately and fixedly mounting the rollers, and wherein the longitudinal section of the shaft is co-axially connecting the two ends.

According to the second aspect of the present invention, there is provided a method for replacing a first circumferential section of a frictional surface with a second

circumferential section of the frictional surface in a feeder for releasing substantially flat items from a stack, wherein the feeder comprises:

a driving mechanism for driving the flat items at a lower section of the stack through a nip, and

a frictional mechanism disposed near the nip so as to allow one flat item to pass through nip at a time, the frictional mechanism having at least a roller for circumferentially mounting the frictional surface, the roller fixedly mounted on a shaft having a longitudinal axis substantially parallel to the nip, wherein the first circumferential section is in contact with the flat items at the lower section of the stack. The method comprises the steps of:

1) providing a locking mechanism comprising:

a locking member having a plurality of facets forming a polygonal outer circumference of the locking member, each facet covering an angular section;

a longitudinal section on the shaft for slideably mounting the locking member, allowing the locking member to locate at a first portion or at a second portion of the longitudinal section while preventing the locking member and shaft from rotating about the longitudinal axis of the shaft relative to the longitudinal section, wherein the locking member is located at the first portion at least when the feeder is in operation;

a blocking mechanism disposed adjacent to the first portion of the longitudinal section of the shaft such that when the locking member is located at the first portion of the longitudinal section, the blocking member prevents the locking member and shaft from rotating about the longitudinal axis of the shaft, and when the locking member is located at the second position, the locking member and shaft are rotatable about the longitudinal axis of the shaft;

2) sliding the locking member from the first position to the second position;

3) rotating the locking member for causing the shaft to turn at least one angular section so as to allow the second circumferential section to contact with the flat items at the lower section of the stack; and

4) sliding the locking member from the second position to the first position.

According to the third aspect of the present invention, there is provided a feeder for releasing substantially flat items from a stack having a lower section. The feeder comprises:

a driving mechanism, disposed relative to the lower section of the stack, for driving the flat items at the lower section of the stack through a nip along a releasing direction; and

a frictional mechanism, disposed adjacent to the nip, for allowing one flat item to pass through the nip at a time, said frictional mechanism comprising:

at least one roller, the roller having a frictional surface fixedly mounted on a circumference of the roller, the frictional surface having a circumferential section in contact with the flat items at the lower section of the stack;

a locking member having a plurality of facets forming a polygonal outer circumference of the locking member, each facet covering an angular section;

a shaft having a longitudinal axis substantially parallel to the nip for fixedly mounted the roller, the shaft having a longitudinal section for slideably mounting the locking member, allowing the locking member to be located in a first portion or a second portion of the longitudinal section; and

a blocking mechanism, disposed adjacent to the first portion of the longitudinal section of the shaft such that

when the locking member is located at the first portion of the longitudinal section of the shaft, the blocking member is at least partially in contact with one of the facets of the locking member, preventing the locking member and shaft from rotating about the longitudinal axis, and

when the locking member is located at the second portion of the longitudinal section, the locking member and shaft are rotatable about the longitudinal axis, causing the shaft to turn, thereby replacing said circumferential section of the frictional surface with another circumferential section of the frictional surface.

Advantageously, the feeder can be used in an addressing machine for releasing envelopes. The feeder can also be used in a mailing machine for releasing enclosure

documents into an insertion station where the released documents are inserted into envelopes. The feeder can be used to release sheets of paper in any paper handling machines, such as printers, photocopiers and the like.

The present invention will become apparent upon reading the description taken in conjunction with Figures 2 to 11.

Description of the Drawings

The above and other objects and advantages of the present invention will be apparent upon consideration of the following detailed description, taken in conjunction with accompanying drawings, in which like reference characters refer to like parts throughout, and in which:

Fig. 1 is ; a schematic representation illustrating a typical friction feeder.

Fig. 2 is ; a schematic representation illustrating the side view of a friction feeder with a frictional mechanism, according to the present invention.

Fig. 3 is ; a cross sectional view of a locking member, according to the present invention.

Fig. 4 is ; a cross sectional view of the shaft section on which the locking member is slideably mounted.

Fig. 5a is ; a front view showing the frictional mechanism, according to the present invention, wherein the locking member is located at the locked position.

Fig. 5b is ; a front view showing the frictional mechanism, according to the present invention, wherein the locking member is located at the unlocked position.

Fig. 6 is ; a cross sectional view showing the locking member in relation to the blocking surface when the locking member is located at the locked position.

Fig. 7 is ; a cross sectional view showing the locking member in relation to the blocking surface when the locking member is located at the unlocked position.

Fig. 8 is ; a schematic representation showing the separation roller in relation to the locking member.

Fig. 9 is ; a cross sectional view of the locking member with a different shape.

Fig. 10 is ; a schematic representation illustrating an addressing machine.

Fig. 11 is ; a schematic representation illustrating a mailing machine.

Detailed Description of the Present Invention

In describing the present invention, reference is made to the drawings, wherein there is seen in Figs. 2 is a schematic representation of a friction feeder having the frictional mechanism, according to the present invention. As shown in the figure, the friction feeder **100** uses a driving mechanism **30** to drive the bottom sheet of document **10** of a stack **20** through the exit nip **62** along the releasing direction **60**. A pair of pickup rollers **70** is used to move the released sheet **10** further along the releasing direction. The retarding element, or the frictional mechanism **140** comprises a pair of separation rollers **140**, each having a cylindrical surface **150** made of a high friction material, such as rubber, urethane or the like securely bonded to the hub of the roller **142** (see Figure 8). The roller hubs **142** and the frictional surface **150** are stationary in relation to the stack **20** so as to prevent more than one sheet **10** from being released. A section **152** of the frictional surface **150** is in contact of the released sheet **10** and other sheets in the singulated portion **24** near the bottom section of the stack **20**. After a long period of operation, the section **152** is eventually worn out, and the frictional surface sometimes allows more than one sheet **10** to pass through the exit nip **64**. In order to eliminate the "double feeds", it is necessary to rotate the rollers **140** by a certain angle so as to allow a fresh, or unused, section of the frictional surface to replaced the worn out section.

The rollers **140** are securely mounted on a shaft **160** (see Figures 5a and 5b). The shaft **160** is mounted on a shaft mount **170** and retained by a pair of shoulder bolts **172**. The shaft **160** is normally locked so that the rollers **140** are stationary. But when the shaft **160** is unlocked, the rollers **140** can be manually rotated. The shaft **160** is locked by a locking member **190**, as shown in Figure 5a.

The locking member **190** is basically a polygonal ring-like body having a plurality of facets **194**. The locking member **190** also has a center opening **192** to fit the cross section of shaft **160**. As can be seen in Figures 5a and 5b, the shaft **160** has a longitudinal section **162**, wherein the cross section is polygonal. As shown in the Figure

4, the cross section of the longitudinal section **162** of the shaft **160** is hexagonal. Thus, the center opening **192** of the locking member **190** is also hexagonal. As such, while the locking member **190** can be moved along the longitudinal section **162** from one part of the longitudinal section **162** to another part, the locking member **190** cannot be rotated relative to the shaft **190**. Thus, when the locking member **190** is rotated when it is not locked, the shaft **160** and the separation rollers **140** are also caused to rotate accordingly.

As shown in Figure 5a, the separation rollers **140** are mounted on two ends of the shaft **160**. Between the separation rollers **140**, the shaft **160** has a longitudinal section **162** for mounting the locking member **190**. In order to lock and unlock the shaft **160**, a blocking mechanism **180** having a block surface **182** is disposed relative to the longitudinal section **162** of the shaft **160**. The blocking surface **182** is adjacent to a portion **166** of the longitudinal section **162**, such that when the locking member **190** is positioned in the portion **166**, as shown in Figure 5a, it is prevented by the blocking surface **182** from being rotated. As shown in Figure 6, when the locking member **190** is positioned in the portion **164**, only a small gap exists between one of the facets **194** and the blocking surface **182**. Because the blocking surface **182** interferes with the rotational movement of the locking member **190**, the locking member **190**, the shaft **160** and the separation rollers **140** are stationary relative to the shaft mount **170**. As such, the frictional surface **150** is locked.

But when the locking member **190** is slid from the portion **166** to the portion **164** of the longitudinal section **162**, as shown in Figure 5b, it is moved away from the blocking surface **182**. As such, the locking member **190**, along with the shaft **160**, can be rotated freely about the longitudinal axis of the shaft, as shown in Figure 7. As such, it allows the operator the replace the worn out section **152** with a fresh surface section **152'** (see Figure 8).

When the friction feeder **100** is in operation, the locking member **190** is located in the portion **166** of the shaft **160** in order to lock the separation rollers **140** in place. But, when it is desirable or necessary to replace the worn out surface section **152** with a fresh surface section **152'** (see Figure 8), the operator moves the locking member **190** from the portion **166** of the shaft **160** to the portion **164**. The operator rotates the locking member

190 by 360°/*N*, with *N* being the number of facets on the locking member **190**. Afterward the operator slides the locking member **190** to the portion **166** of the shaft **160** in order to lock the separator rollers.

Preferably, the outer perimeter of the locking member **190** is hexagonal, formed by six facets **194**. However, the number of facets can be any suitable integer, depending on the size of the locking member and the width of the contact section **152**. The number of facets can be as small as three to form a triangle, and as large as twelve or more. Furthermore, the shape of the outer perimeter of the locking member **190** can be the same as the shape of the center opening **192**, as shown in Figures 3 and 4. However, it is possible that the shape of the outer perimeter is different from the shape of the center opening **192**, as shown in Figure 9. In Figure 9, the outer perimeter is octagonal, but the center opening **192'** is square. In that case, the cross section of the longitudinal section **162'** of the shaft is also square. Thus, in general, the shape of the outer perimeter is polygonal, so that the replaced section **152'** of the frictional surface **150** is consistently determined by the rotational angle 360°/*N*, with *N* being the number of facets of the outer perimeter. Furthermore, the cross section of the shaft section **162** can be regular polygonal, such as that shown in Figures 4 and 9, but it can also be a rectangle, a "D" shape, or the like, so long as the locking member **190** can be slid between the portion **164** and the portion **166** when desired and the shaft **160** is caused to rotate along with the locking member **190** when the locking member **190** is rotated about the longitudinal axis **260**.

It should be noted that the item **10**, as shown in Figure 2, can be any substantially flat item. For example, it can be an envelope, a mailpiece, a sheet of paper or the like. Thus, the friction feeder **100**, according to the present invention, can be used to release envelopes or mailpieces in an addressing machine **500**, as shown in Figure 10. As shown in the figure, the feeder **100** is used to release envelopes, one at a time, to a printing section **300**, wherein a plurality of printing assemblies **340** are used to print a mailing address, return address or promotional messages on the envelope **10**. One or more feeders **100** can be used in a mailing machine to separately release enclosure documents. The release documents are gathered into a stack **110** and conveyed to an inserting station **550**, where the stack of enclosure documents is inserted into an

envelope. Furthermore, the feeder **100** can be used in any paper handling machine where paper is fed one sheet at a time for printing, photocopying or the like.

Moreover, the blocking member **182**, as depicted in Figure 6, does not have to be a flat surface. It can be a rod, a curved surface or the like, so long as the blocking member **182** can prevent the locking member **190** from rotating about the shaft when the locking member **190** is located adjacent to the blocking member **182**.

While the present invention has been disclosed and described with reference to a single embodiment thereof, it will be apparent, as noted above that variations and modifications may be made therein. It is also noted that the present invention is independent of the machine being controlled, and is not limited to the control of inserting machines. It is, thus, intended in the following claims to cover each variation and modification that falls within the true spirit and scope of the present invention.